Oregon
Kate Brown, Governor

Water Resources Department
725 Summer St NE, Suite A
Salem, OR 97301
(503) 986-0900
Fax (503) 986-0904

November 23rd, 2016

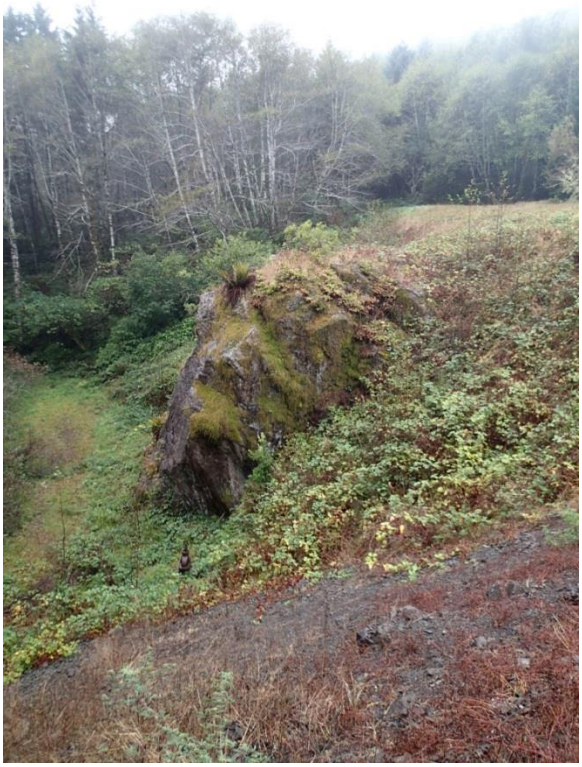
Paul Stevens, Public Works Director
City of Brookings
898 Elk Drive
Brookings, OR 97415

Re: Ferry Creek Dam (F-25) – Inspection Summary

I inspected this dam on October 4, 2016, with Dam Safety Specialist, Tony Janicek, District 19 Watermaster Greg Wacker, and Water Resource Engineer Lyndsey Croghan. You, along with Chrissy Bevens and Ray Page from the City of Brookings Public Works, were also there for the inspection. The Water Resources Department conducts routine inspections of the dam's exterior surfaces to identify conditions that might affect the safety of the dam. Dams are assigned a hazard rating based on downstream hazard to people and property, not on the condition of the dam. The department has classified Ferry Creek Dam as a high hazard dam and therefore we inspected it annually.

Summary: The dam has not been operated recently for water supply purposes and is in UNSATISFACTORY condition. Several issues of concern were identified at the dam and are illustrated and described in the following photos and text.

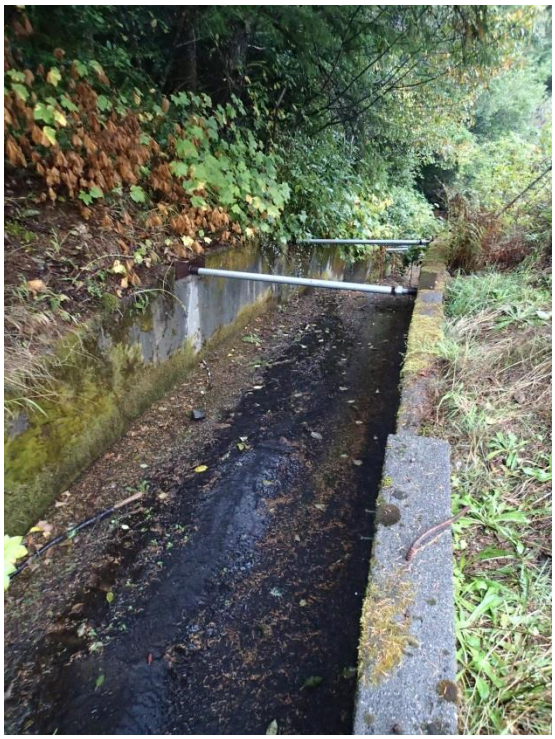
Results of Inspection:



Vegetation on the downstream slope, right abutment and toe of the dam

The reservoir level was 3.1 feet below the dam crest when inspected. Minimum freeboard was 2.1 feet, which is potentially unsafe due to the condition issues with this dam. On the dam crest, soil has settled and created a low spot which lowers the total reservoir storage by approximately 2.4 feet.

Low spots on the dam crest are typical of older earth fill dams and occur as a result of crest movement due to settlement or compaction of the soil material. Settlement occurs naturally overtime through settlement of the soil particles while compaction occurs through animal or human activity. Low spots on the crest reduce the minimum freeboard which can increase the potential for overtopping of the dam during a significant storm event. Overtopping of the dam can lead to a catastrophic dam failure.

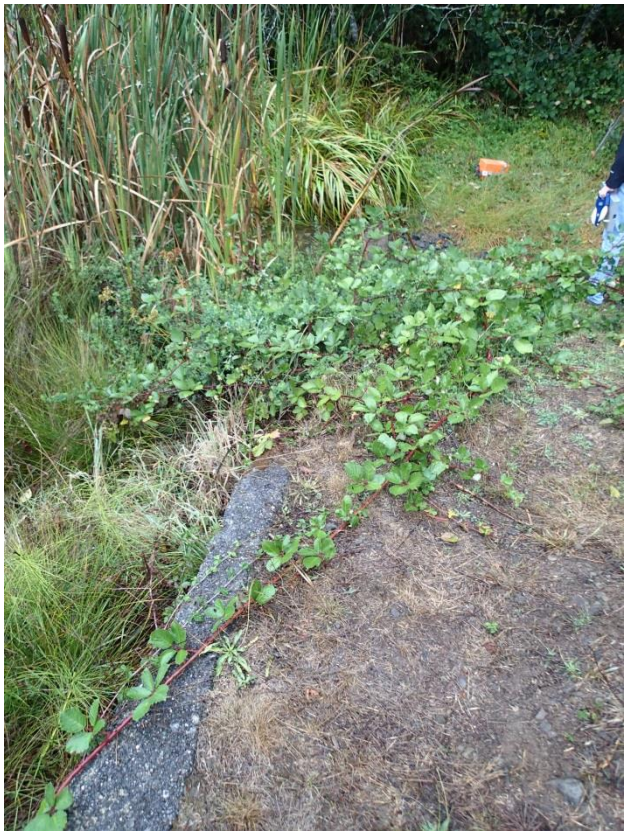


Steel struts preventing spillway channel retaining wall failure

Based on measurements taken during our inspection, the spillway appears to be undersized for a moderately sized storm event. It should be noted that the only definitive means to determine if the spillway is truly undersized, is through a detailed engineering analysis. However, our rough calculations indicate that there is enough reason for concern regarding the spillway capacity without the need for a full engineering analysis at this time. Consequently, it is extremely likely that in a moderately sized storm event the dam will be overtopped, possibly leading to a catastrophic failure of the dam.

In addition, the retaining walls of the discharge channel for the spillway are beginning to fail. The walls are currently held in place by steel struts. These struts are located within the spillway channel and therefore present an obstruction to flow. As a result, the capacity of the spillway is reduced from the "as-designed" condition.

Vegetation in the emergency spillway control section

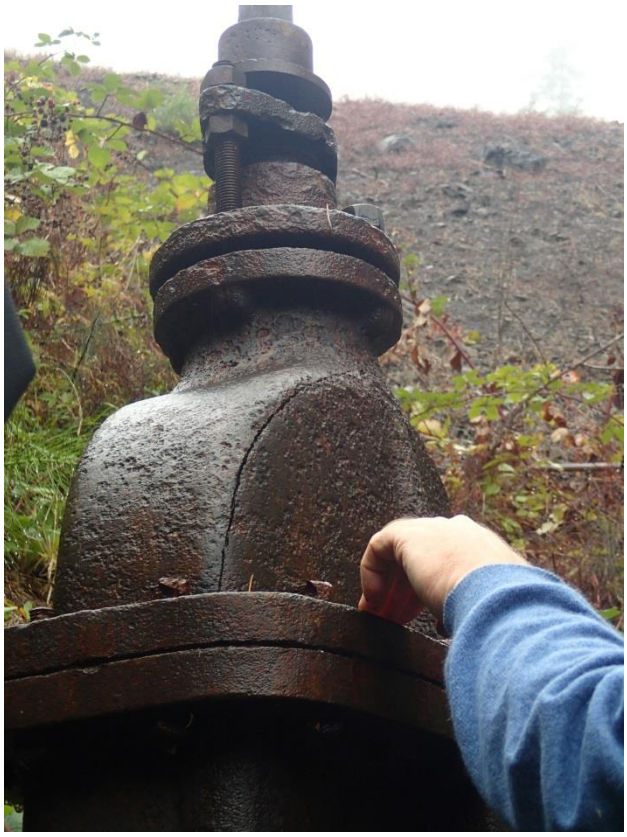


Partially buried spillway control section

There is a significant amount of vegetation in the emergency spillway control section and channel. It also appears that there was land slide into the spillway at some point in the past. This is evidenced by the fact that the control section (shown in the image above) is partially buried and the section, in its current condition, is not uniform. It also appears that there is a significant amount of material in the discharge channel just downstream of the control section. Both the vegetation and the material from the slide obstruct flow through the spillway and therefore reduce the capacity of the spillway to pass flood flows.

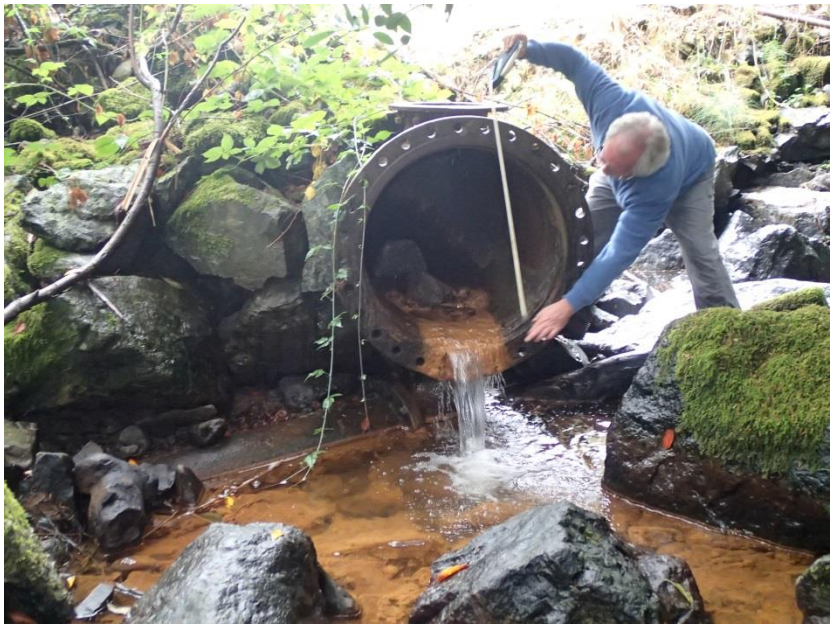
There is also a significant amount of vegetation on the downstream face, left and right abutments, and toe of the dam. Extensive vegetation prevents complete inspection of the dam surface and outlet control works. Visual inspection makes it possible to identify any deficiencies that may lead to unsafe operation of the dam; it is a critical component of a dam safety inspection. Common issues identified through visual inspection are embankment stability and movement, seepage, animal activity, poor condition of penetrating conduits, and lack of functionality of the outlet works.

Intermediate conduits with valves



Crack in housing of upper most intermediate valve

There are multiple conduits that penetrate through this dam. This is very atypical. Each conduit provides a potential location for leakage into the dam. Two of the conduits have valves on the downstream side which suggests that they might be pressurized. However, the upper intermediate conduit (upper left in the photo above) has a cracked housing so it is likely not pressurized. A conduit is pressurized when the control valve is at or below the outlet of the dam, instead of in the reservoir on the upstream face. Most dams are designed for gravity flow, not for pressurized conduits. Conduits are pipe, and depending on the type of pipe and the age of the pipe, risk of high-pressure leakage exists in a pressurized system. In an earthen dam, this high pressure water can cause severe internal erosion, and this can result in rapid dam failure. It does not appear that either of the two intermediate conduits has been used in some time.



Low level conduit

There is also a low level conduit that is not pressurized. This pipe is clearly leaking at approximately 15 to 20 cubic feet per second. Either the gate valve on the upstream side is partially open or there is a leak in the upstream valve or somewhere along the conduit. We were unable to inspect the upstream gate valve because it was submerged. There are no visible controls for the low level conduit. As a result, it is not operable. A properly working outlet conduit is a key safety feature of a dam. The controls and conduit must be functional to drain the dam during an emergency.

The combination of the low spot on the crest, the issues with the spillway, multiple non-functional conduits, and the fact that the dam is located in a high-seismic shaking zone all cause this dam to remain in UNSAFTISFACTORY condition.

Thank you for your recent efforts in developing a plan to make this dam safe. Please continue to work on this plan. I will support your efforts in any way that I can. Please don't hesitate to contact me, or other members of the dam safety staff, with any questions.

Recommendation(s):

1. Restore the dam crest height to the as designed condition by filling in the low spot(s) on the dam.
2. Monitor the reservoir level and freeboard if over 4 inches of rain in 24 hours has or is occurring.
3. Increase the minimum freeboard. A safe operating condition would be a minimum freeboard of no less than five feet. However, due to issues with the outlet conduits there is currently no way to release water from this dam. As a result, the safest way to release water would be through a siphon.
4. Remove debris and vegetation from the spillway channel so that the channel remains unobstructed and functions as designed.
5. Remove vegetation from the downstream face of the dam, right and left abutments, and toe of the dam.
6. Continue to analyze the safety of this dam and develop a plan for rehabilitation or removal based on analysis of the safety of the dam and the City's need for additional water supplies
7. An Emergency Action Plan should be developed for this high hazard dam. We will work with you on preparing a draft EAP.

We use a standard inspection form, and a copy of the field inspection sheet for this dam is attached. Thanks again for meeting with us. I plan on another routine inspection next year. Please let me know if you have any questions about this inspection. I look forward to future inspections of this dam.

Sincerely,

Keith Mills, P.E., State Engineer
(503) 986-0840
Cell (541) 706-0849

C: Greg Wacker, Watermaster District 19
Dam Safety File F-25

Dam Safety
Inspection Form

State of Oregon
Water Resources Department
725 Summer Street NE, Suite A
Salem, Oregon 97301-1271
(503) 986-0900

Name of Dam: FERRY CREEK File #: F-25
Height: 65 ft. Storage: 167 ac. ft. Permit: R-4720 NID #: OR- 00437
Hazard: ☐ Low ☐ Significant ☑ High ☐ **Request Inundation Analysis for change**
Inspector(s): MILLS, WAGNER, CROGHAN, JANICEK Watermaster District: 19
Others on site: CHRISTY STEVENS, PAUL STEVENS, RAY PAGE
Date: 10/04/2016 Weather: OVERCAST
Prior Inspection Date: 10/6/15 Issues from prior inspection: _____

Expedited Re-inspection Needed: ☐ Next Inspection Date: 2017

***Rating Criteria**: 5-Very good; 4-Adequate 3-Maintenance or minor repair needed*
*2-**Serious repair needed; 1- Urgent dam safety issue – action now - Contact dam owner and dam safety engineer directly***

I. Dam	☑ Earth ☐ Rock ☐ Concrete ☐ Other	Rating
Up. Slope	Vegetation, Animals, Erosion, Wave Action, Depression, Whirlpool adjacent (MINOR VEGETATION)	4
Crest	Width, Surfacing, Vegetation, Trampling, Depression, Cracks, Breaching (FAIR OF VEG. LOSS SPOT (AT 2.4' LOWER))	3
Down. Slope	Vegetation, Animals, Erosion, Seepage, Leak (muddy), Bulge, Depression, Slide (MINOR VEG (MOSTLY BLACKBERRIES))	3+
R. Abutment	Vegetation, Animals, Erosion, Seepage, Leak (muddy) (VEGETATION)	4-
L. Abutment	Vegetation, Animals, Erosion, Seepage, Leak (muddy) (VEGETATION)	4-
Toe	Vegetation, Erosion, Seepage, Leak (muddy), Boil (VEGETATION)	4-
Seepage/leak flow	Right ____ gpm Center ____ gpm Left ____ gpm Other ____ gpm (use comment)	—
Auxiliary dike (s)	☑ No ☐ Yes ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ over 5	—
Comments:		

II. Reservoir	Pool elevation: 3.1	Point of Reference: DAM CREST	Rating
Minimum freeboard	Vertical distance debris from debris line to crest 2.1 ft.		3
Floating Debris/Trash	☑ Clean ☐ Around reservoir ☐ Near spillway		4
Log Boom	☑ Not needed ☐ Present ☐ Needed ☐ Deterioration ☐ Ineffective		—
Unusual Conditions	☐ None ☐ Active Landslide ☐ Wildfire in Watershed ☐ Other (comments)		—
Comments:			

III. Toe Drains #									
Flow (gpm)									
Damage									
Sediment									
Rating									

IV. Conduit	Control: ☐ Manual ☐ Power ☐ Other ☐ Conduit Control missing	Rating
Inlet gate	☑ Submerged	—
Trash Rack	☑ Submerged	—
Control/Stem	☐ Clean ☐ Greased ☐ Irregular NOT OPERABLE	3
Valve(s) cycling	☐ Frozen ☐ unknown ☐ past year ☐ frequent NOT OPERABLE	3
Diameter:	Material CS Condition RUSTED, OTHERWISE UNKNOWN	3
Outlet Structure	☐ Overgrown ☐ Clean ☐ Pressurized ☐ Leaking _____ gpm UNKNOWN	3
Secondary outlet	☐ Yes ☑ No Type _____ Diameter _____ in.	—
Comments:	• UPPER PIPE 16" CONCRETE PIPE W/ 16" CRANE GATE VALVE. HOUSING IS CRACKED SO IT IS NOT LIKELY IT IS PRESSURIZED • MIDDLE VALVE ? • LOWER VALVE 30" CS, 15-20 CFS LEAK	

V. Spillway	☑ Earth ☑ Rock ☑ Concrete ☐ Other	Rating
Modifications	☑ None ☐ Reduction in capacity ☐ Feature not on design	—
Approach Channel	☐ Clear ☑ Trees/brush ☑ debris ☐ erosion	3
Control Section	Width VARIES Depth VARIES ☑ Concrete ☐ Rock ☑ Soil ☐ Culvert ☐ Unstable	3
Flashboards/Gate	☑ None ☐ In place ☐ operational ☐ deteriorated	—
Discharge Channel	☐ Clear ☑ Trees/brush ☐ leakage ☐ headcutting (____ feet approaching control section, depth ____ feet.)	3
Stilling basin	☑ N/A ☐ Functional ☐ Minor Erosion ☐ Severe Erosion/Undercutting	—
Aux. Spillway	☐ Yes ☑ No (use comments below)	—
Comments:	SECTION OF CONCRETE CHANNEL WHERE ROUGH COAX. MEETS SMOOTH THERE IS A LEAK. LEAK COULD BE DUE TO GW FLOW/RUNOFF	

VI. Access and Security		Rating
Vehicle access	☐ Public road ☐ all weather road ☑ dirt road ☐ cross country	—
Fencing, signage	☐ Remote ☑ Gate ☐ Secure Fence ☐ Camera ☐ Uncontrolled	4
New Structure below dam	Dwelling ___ feet Paved public road ____ feet Other sig building ____ feet	—
Emergency Action Plan	☐ Not required ☐ Completed _____ at dam (dated_____) ☑ None	3
Comments:		

Instrumentation data reviewed: ☐ N/A ☐ Yes ☐ No

Other:

- LOW SPOT ON CREST NEAR SPILLWAY
- FREEBOARD
- SPILLWAY - CLEAR
- OUTLET CONDUIT